$\bar{p}p$ Physics in the Antiproton Source
-- Beam Issues --

1. **Past performance**
   a. **Preparations & Required BD support**
   b. **Antiproton Source Performance**
2. **Prospects for the future**
   a. **Preparations & Required BD support**
   b. **Expected performance**

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5/10/2001

Overview of 2000 Fixed Target Run

The Run:

Deceleration Ramp Development: **Aug. 27 – Nov. 16, 1999**

~3 people × 2½ Months = 7.5 man-months (above transition ramps only)

Engineering Run **Jan. 19 – Feb. 7, 2000**

Running Period: **April 4 – Nov. 9, 2000**

Statistics:

Total Integrated Luminosity: **113 pb^{-1}**

E835 2000 Integrated Luminosity Slide

Max. Instantaneous Luminosity: **4.0×10^{31} cm^{-2} sec^{-1}**

Target Density = 4×10^{14} atoms/cm^3

$\mathcal{L}$, Target Density – Slide 1

$\bar{p}$ Stack = 2×10^{11}

$\mathcal{L}$, Target Density – Slide 2

E835 Gas Jet Target Photo

Beam Loss Rate @ Max Luminosity: **~1.5×10^{10} $\bar{p}$/hr**

$\bar{p}$ Stacking Rate: **2 - 3×10^{10} $\bar{p}$/hr**

Center of Mass Energy Range: **3340 – 4270 MeV**

⇒ Entire range above Accumulator transition energy

2000 Deceleration γ_t Ramp

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Significant Aspects of Antiproton Source Performance

Deceleration:

- **Managed by PAUX -- a special Pbar front-end process**
  Pbar front-end recently replaced ⇒ No More PAUX
- **Typically, 5 – 25 % of beam lost before target ON**
- **Time required: 0.5 – 5.0 hours**
- **Biggest stack decelerated: ~80×10^{10} $\bar{p}$**
- **Biggest stack decelerated through transition: 25×10^{10} $\bar{p}$**

Deceleration to the χ_0
One week of E835 Operations

Beam energy control:

- **Implemented Beam energy feedback control using movable momentum cooling pickups**
- **Beam energy stable to ± 50 keV in center of mass frame**

Energy Control

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Significant Aspects of Antiproton Source Performance (Continued)

Beam energy measurement:

- Accomplished by measuring beam velocity (derived from separate measurements of orbit length and beam revolution frequency)
- Calibrated by scans of narrow resonances (e.g. ψ')
- Error is:

$$\frac{\delta E_{cm}}{E_{cm}} = \gamma \left(\frac{pc}{E_{cm}} \right)^2 \left(\frac{\delta f_{rev}}{f_{rev}} - \frac{\delta L}{L} \right)$$

- $\delta L \cong 1.5$ mm (out of 474.05 m),
  $\delta f_{rev} \cong$ 0.1 Hz (out of 0.625 kHz)
  $\delta E_{cm} = 224$ keV at the ψ' (3686 MeV/c^2)
  $\delta E_{cm} =$ 75 keV at the J/ψ (3097 MeV/c^2)

Beam energy distribution measurement:

Beam energy distribution obtained from longitudinal schottky pickups.

Beam Energy Spectrum

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Can we do it again?

What will have changed:

1) **Stacktail cooling upgrade – this is the biggest issue**
   - **Stacking rate *before* upgrade: 20×10^{10} $\bar{p}$/hr**
   - **Max. Stack size *before* upgrade: 200×10^{10}**
   - **Stacking rate *after* upgrade: 100×10^{10} $\bar{p}$/hr ?!**
   - **Max. Stack size *after* upgrade: 20×10^{10}**
2) **Recycler – To be or not to be – that is the question.**
   - **Without the recycler the stacktail upgrade will not be installed**
     - $\Rightarrow$ Big stacks
     - $\Rightarrow$ Slow stacking
     - $\Rightarrow$ No place to "stash" a reserve supply of $\bar{p}$'s in case collider store is lost
3) **Controls**
   - **New pbar front end $\Rightarrow$ Deceleration will require a new PAUX to be written – *long lead time***

Need new console software to manage deceleration and beam control during a store.

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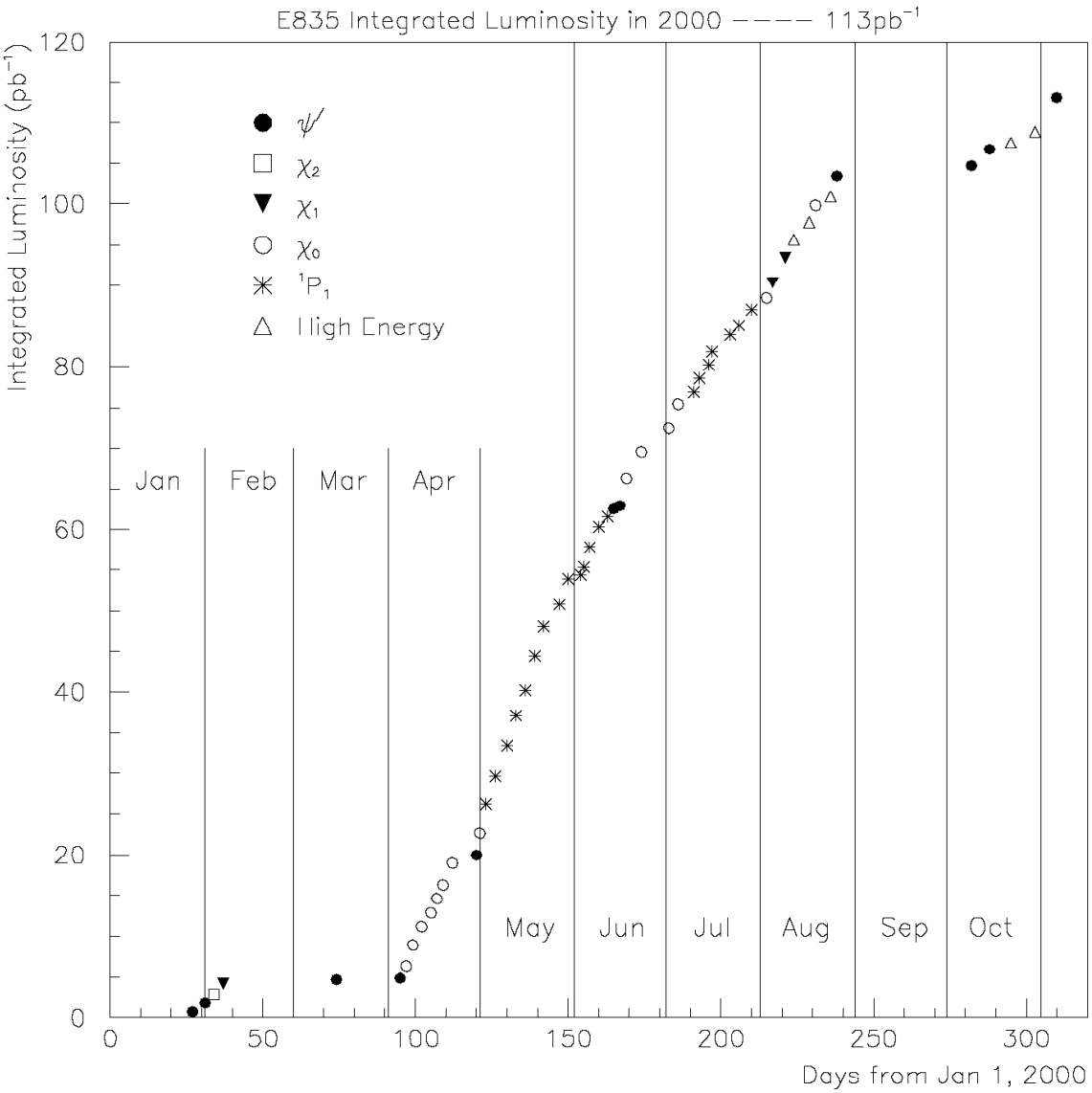
Can we do it again? (continued)

4) Deceleration Ramps

- **Ramps to E_{cm} = 3300 MeV in hand. *However*, experience has shown that it's best to start from scratch every run.**
- ***May* be able get to J/ψ (E_{cm} = 3097 MeV) without crossing transition**
- **For low energies, transition will have to be crossed**
  - Limited beam can be transmitted through transition
    $< 25\times10^{10}$ $\bar{p}$
  - Transition crossing ramps and below transition deceleration ramps will have to be constructed
    $\Rightarrow$ This at least doubles the ramp development time

2000/11/16 13.29



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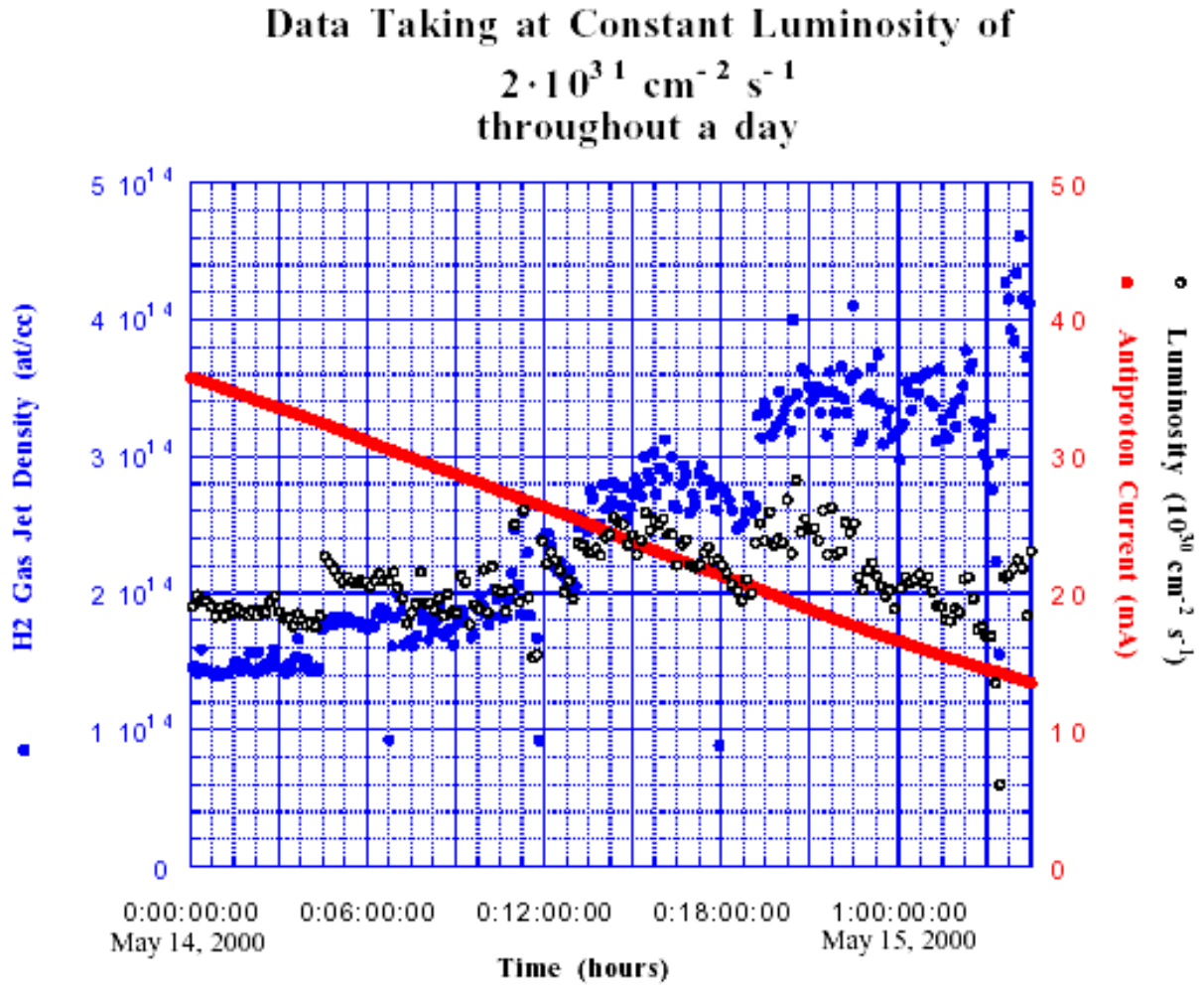

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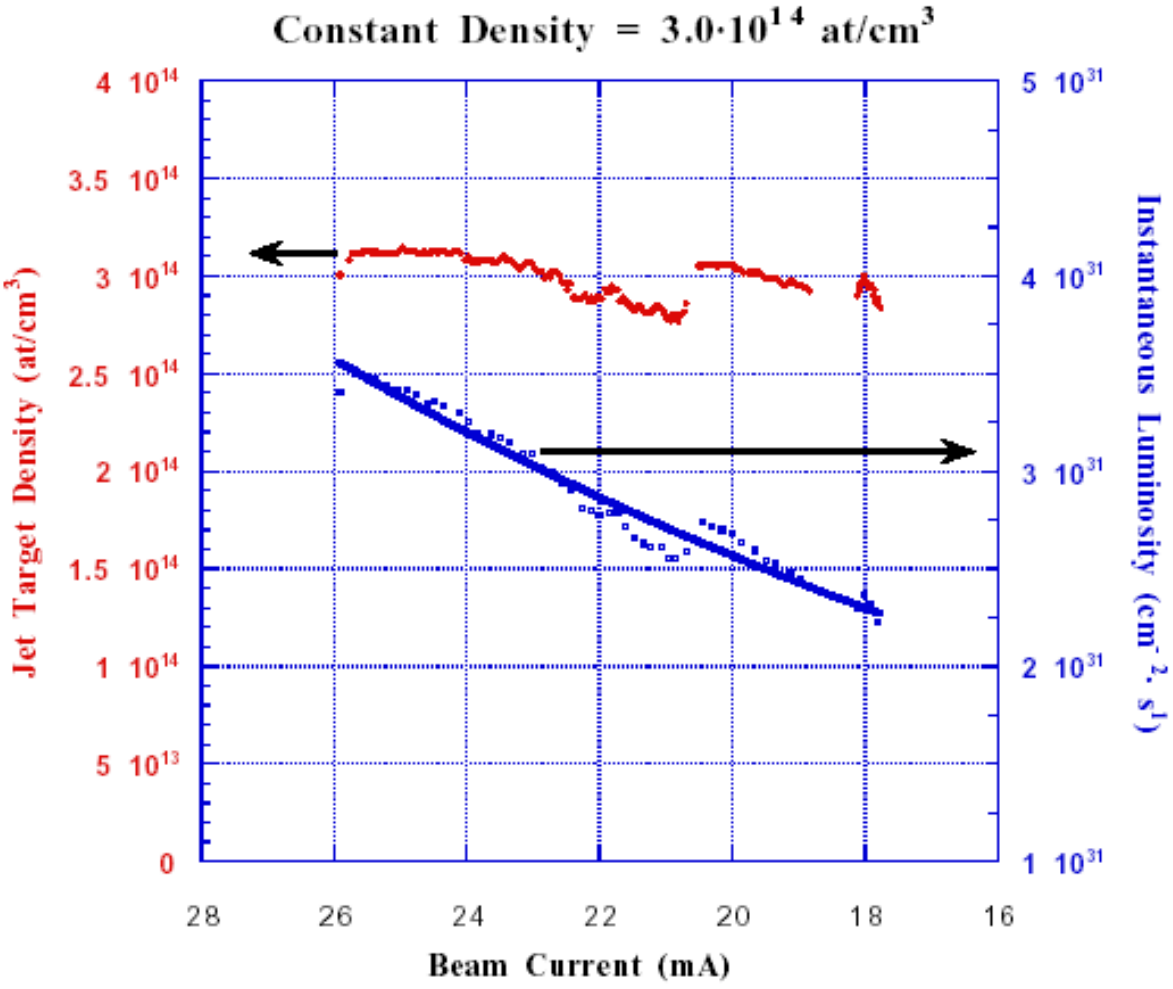

Gabriele Garzoglio (Jan '97)

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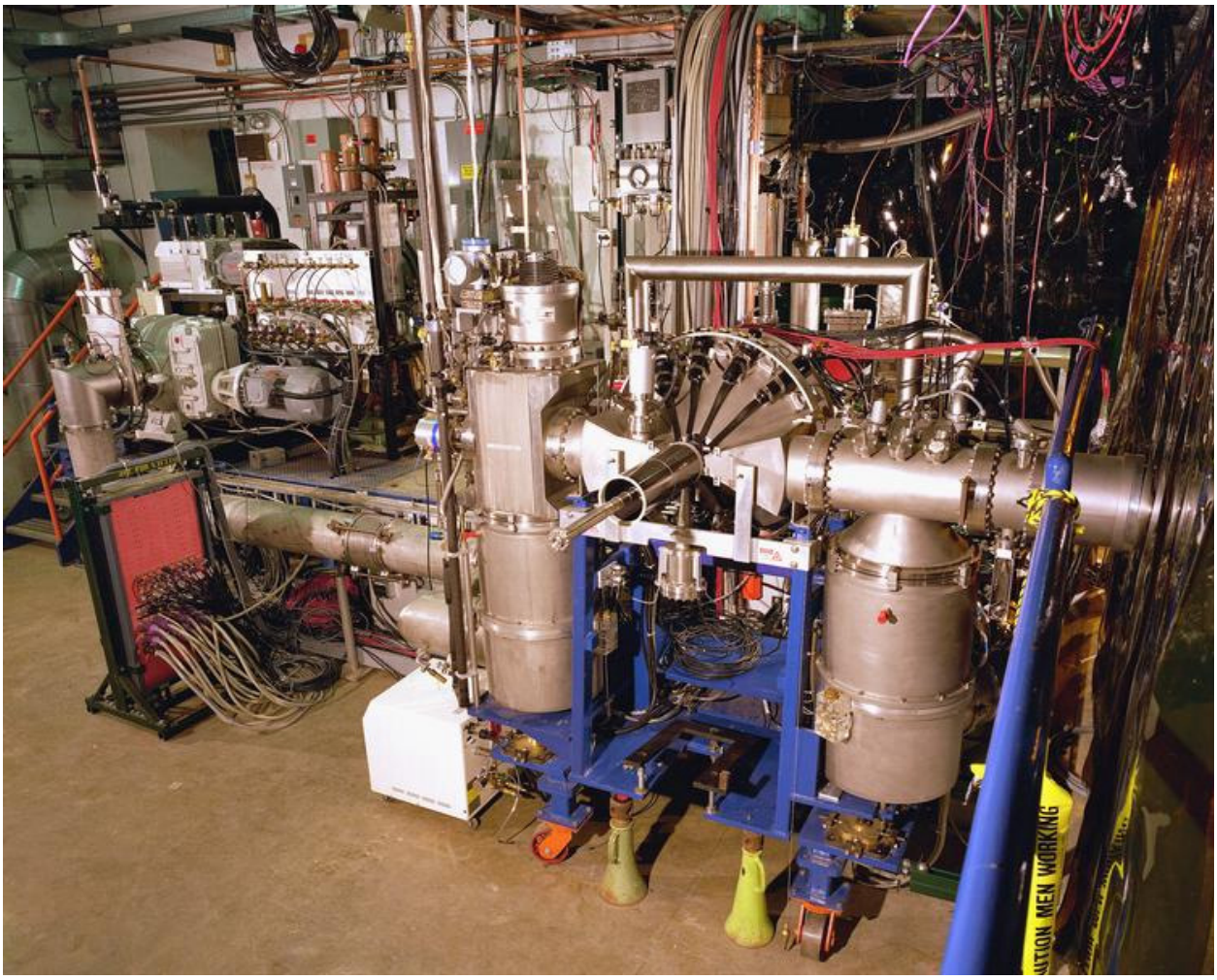

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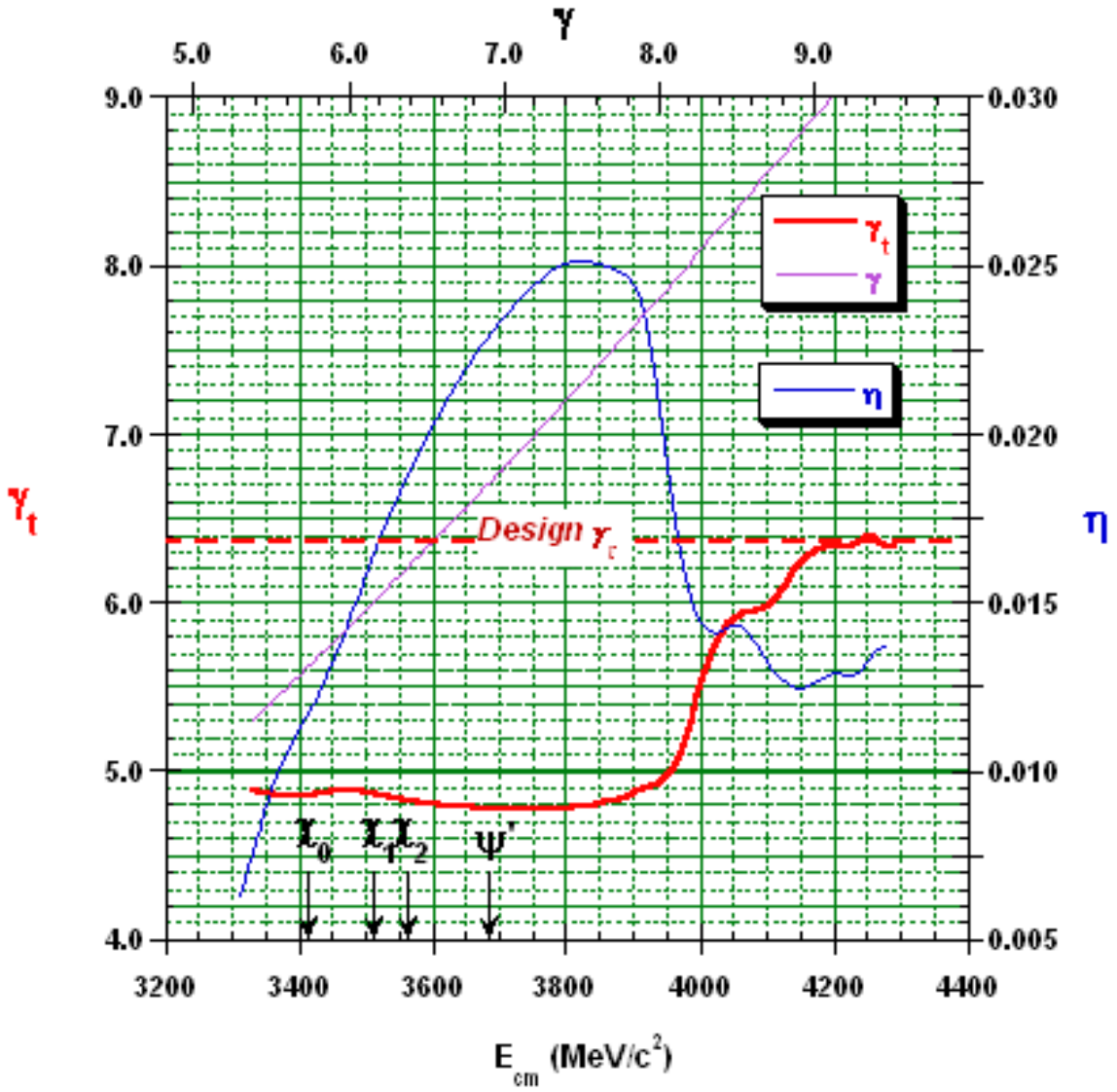
1999 - 2000 Deceleration Ramps



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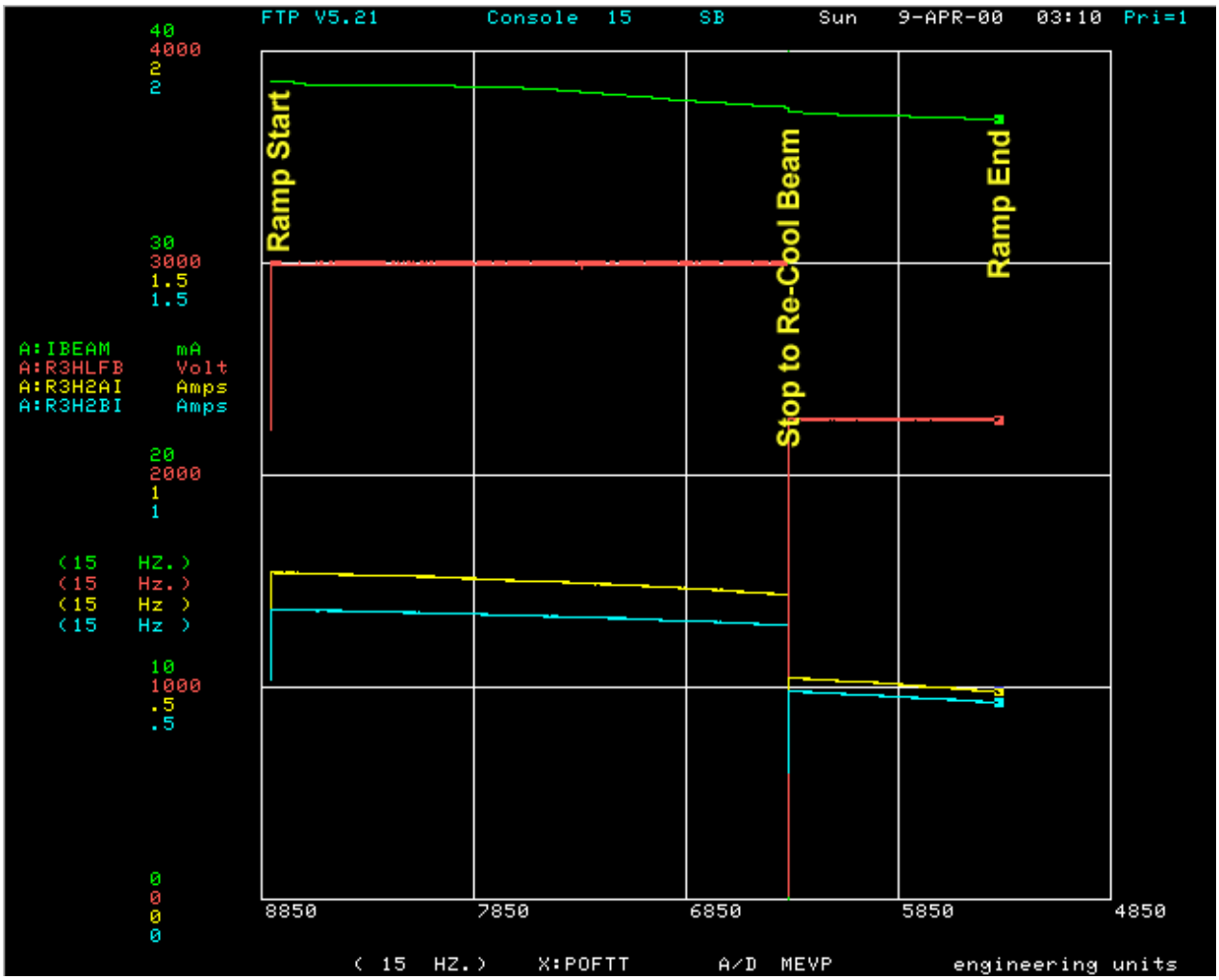

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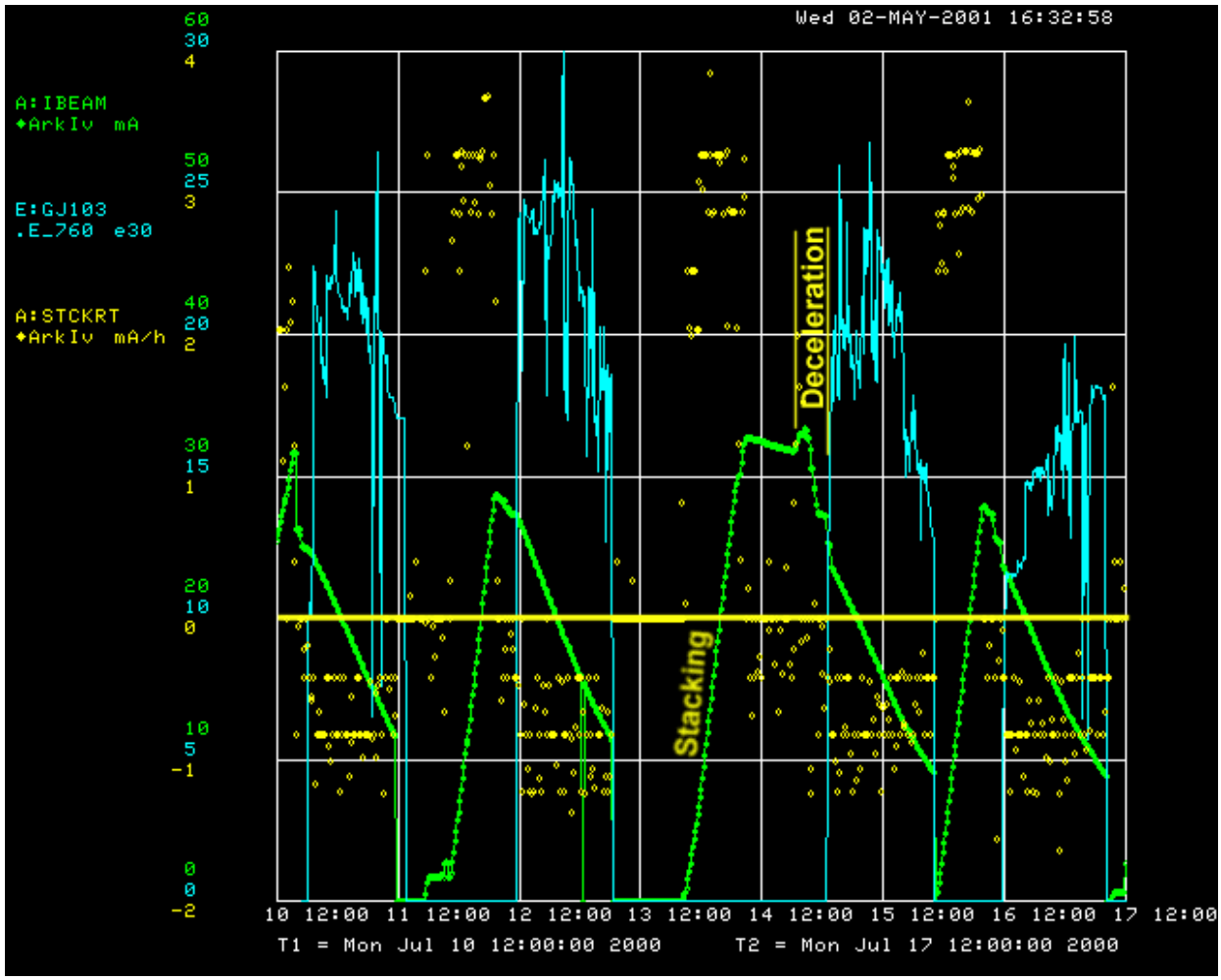

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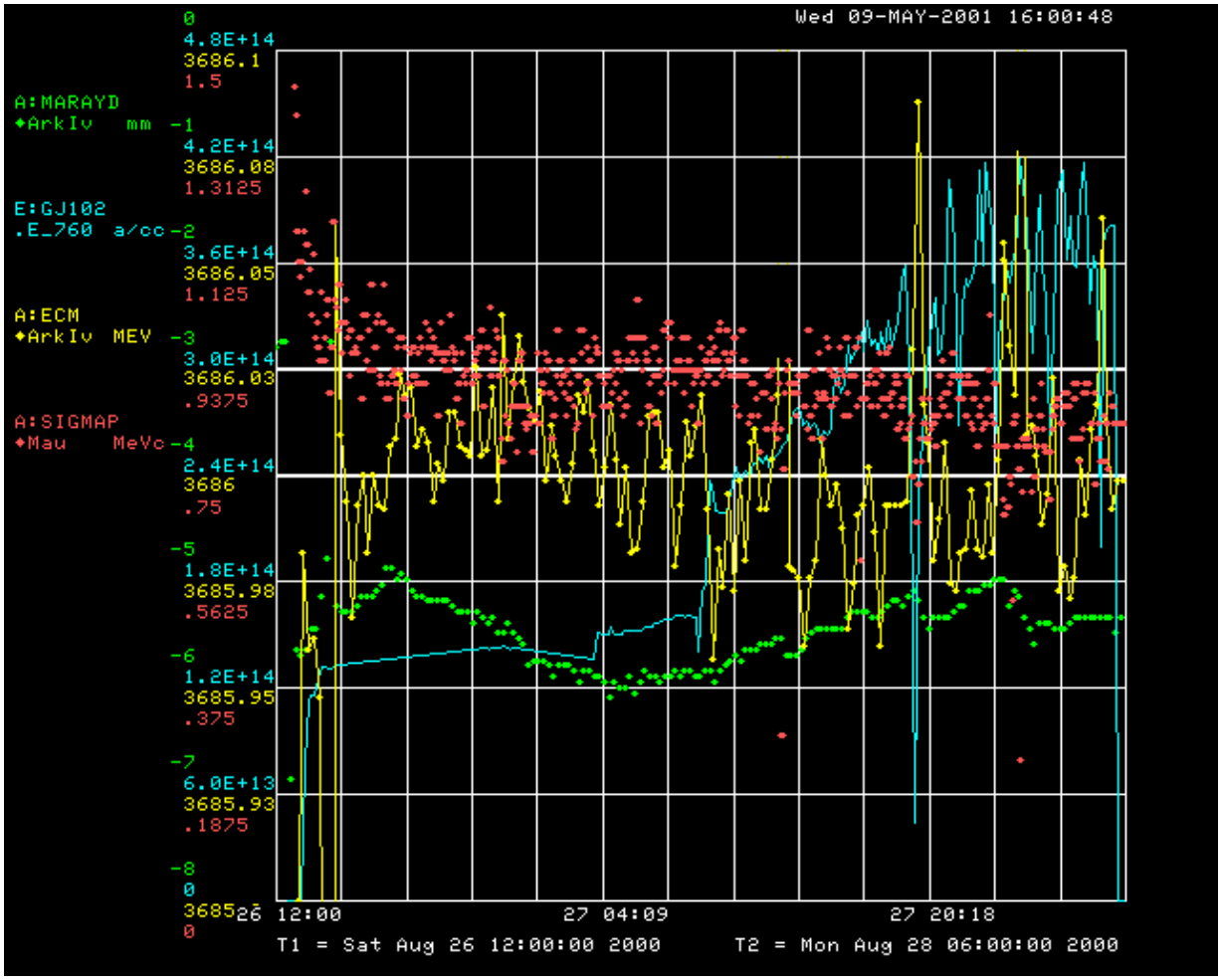

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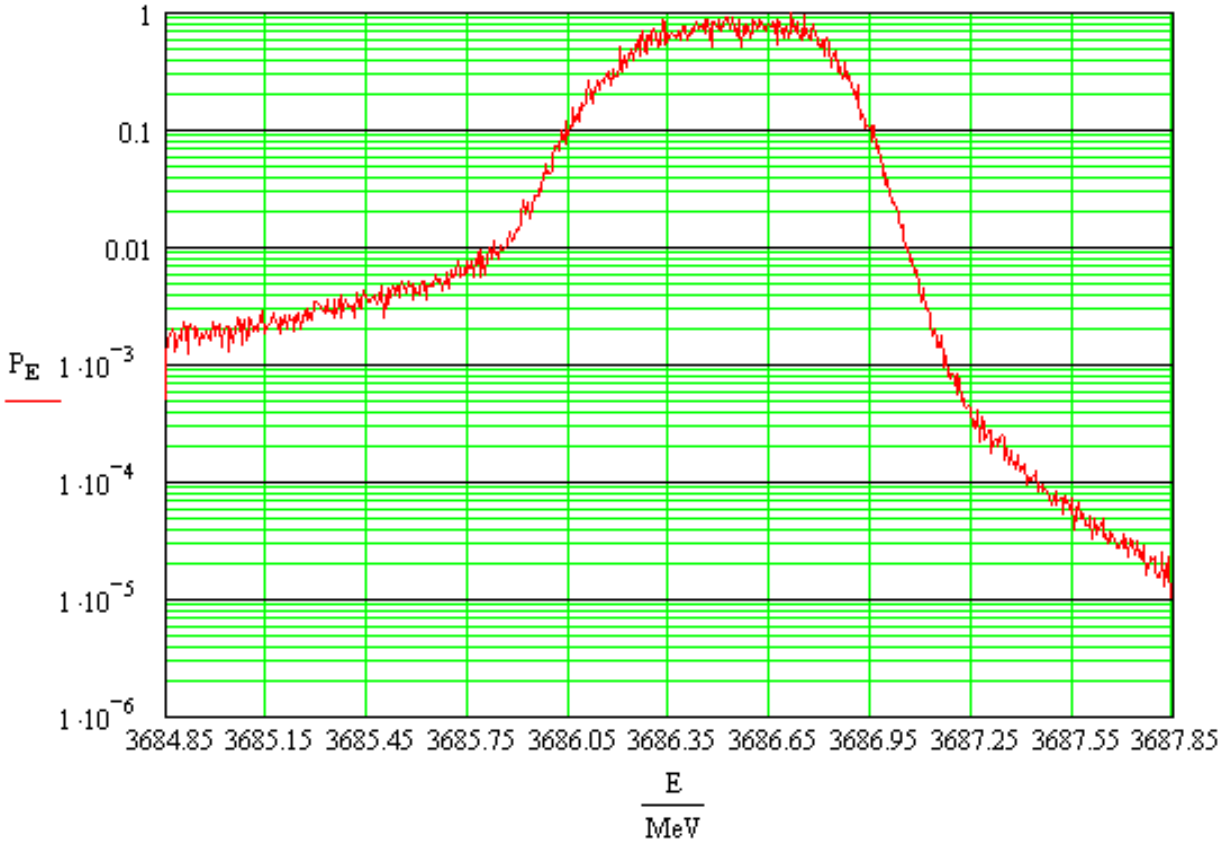

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